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THE TECH ENGINEERING NEWS

FEBRUARY, 1935
VOLUME XV
NUMBER 8

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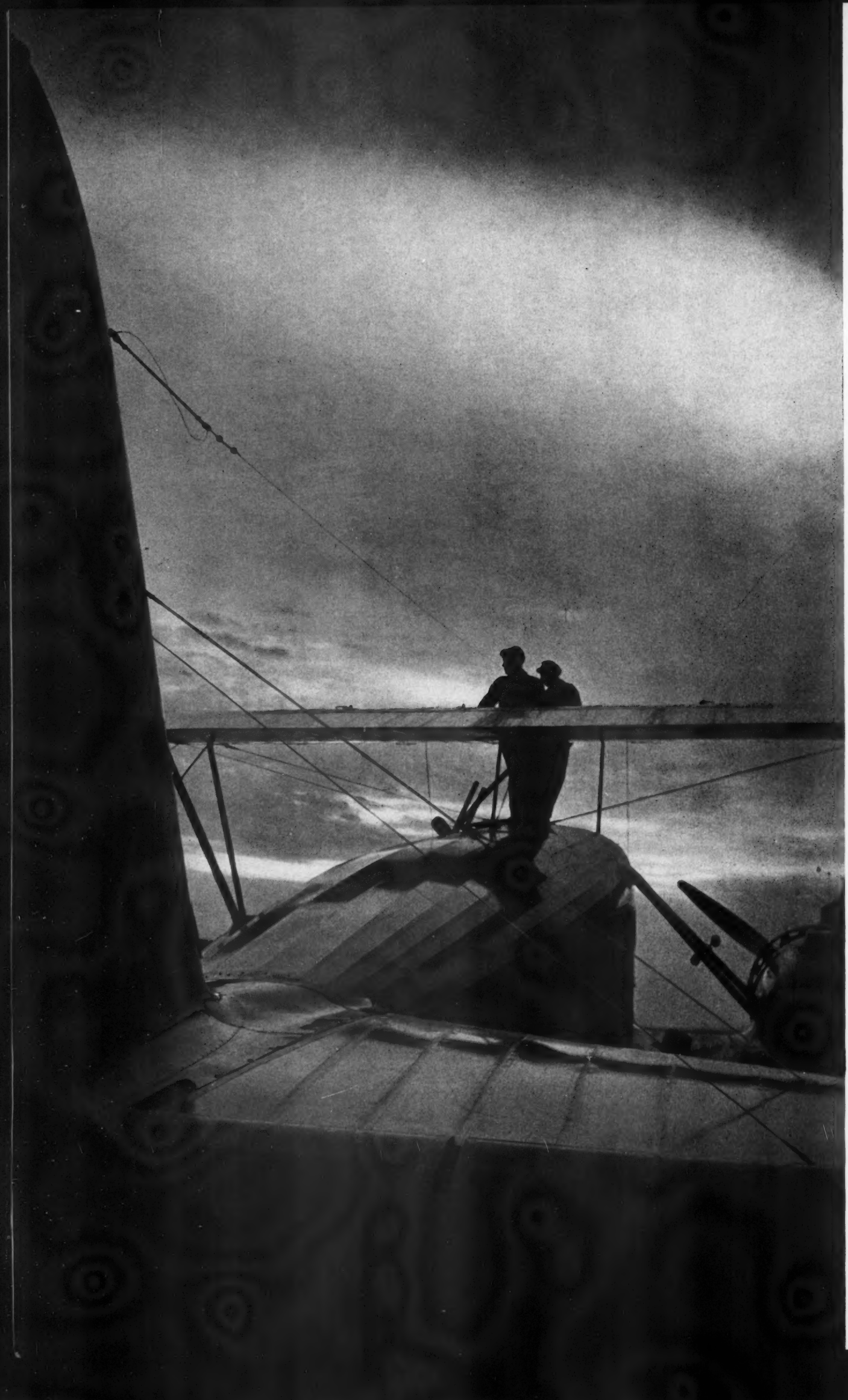


DAY'S
END

PLACEMENT ACTIVITIES AT M. I. T.*

By JOHN M. NALLE '20
Placement Officer
Massachusetts Institute of Technology

THE necessity for constant and prompt attention to two phases of placement activity, namely, alumni placement, and student placement training, is well recognized by the faculty and administration of the Massachusetts Institute of Technology. Since approximately 600 students are graduated from the Institute each year, the magnitude and importance of the placement training program is apparent. If we assume the average earning capacity of these men over a period of years is $5,000 per annum, that amounts to a total annual income of $3,000,000. The combined efforts of the faculty and students to get the students started in the right position after graduation might easily affect that total by 20 per cent., that is, alter the annual income of the group by $600,000.

The placement training program was organized three years ago. It has as its major purpose the better training of our students to meet the needs of science and industry by enabling them to get started early on the types of work for which they are best fitted by personality, special aptitudes, and training.

The program is planned to give the students an insight into the requirements of and the opportunities in different branches of industry, and to impress upon them the basic principles to be observed in seeking employment. The students who have definite openings to move into after graduation are advised to take part in this program, because we believe that a knowledge of the principles to be followed in seeking employment will be of value to them in many of their future contacts.

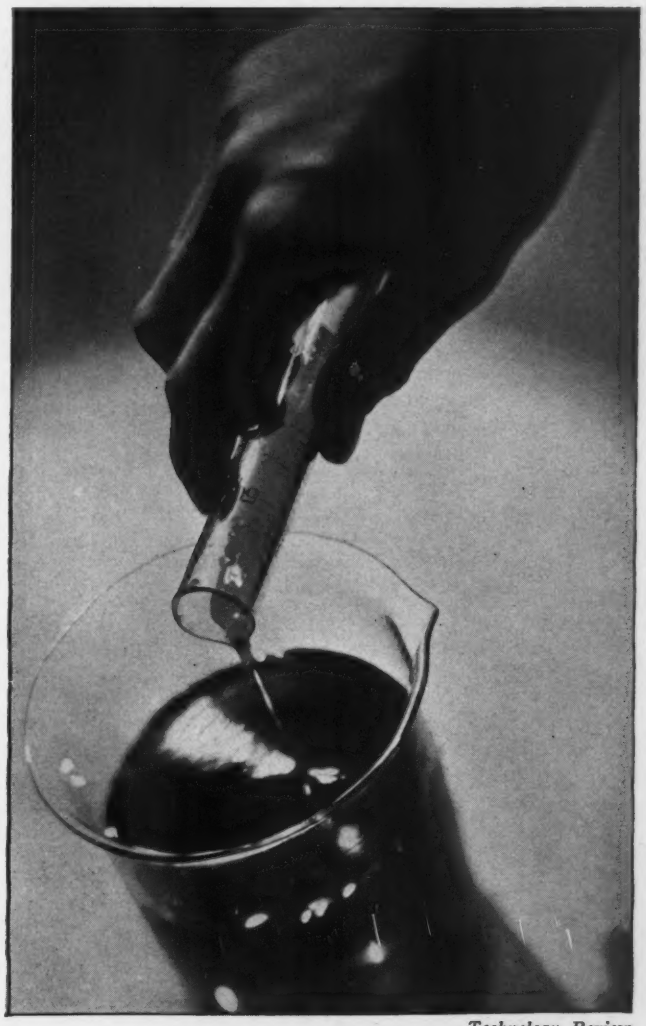
In talking to the seniors about placement, we think of it in its broadest sense; not as an emergency, and not in terms of what they will be doing in July, 1935; but rather in terms of their entire careers. The first positions which they secure will affect their careers enormously, and we feel that it is more important for them to locate the correct type of opening in line with their special aptitudes and training than for them to start work during the first month after graduation.

Previous to 1930 practically every man who successfully completed his work at the Institute found an opening almost without effort on his part. We realize now that perhaps that was unfortunate, because when it was so easy for our graduates to find openings, they accepted the proposition that seemed to offer the greatest immediate opportunities. They did not investigate other fields which might have afforded greater future possibilities. We feel that the effort the students and faculty are now putting into the problem of finding the proper position will result in a greater permanency of placements. That is, the men will find the openings where they can use their training to the greatest advantage. A recent survey has shown that a very small percentage of the 1933 graduates who secured positions during the summer of 1933 have lost or changed those original positions.

A study of our alumni indicates that the men who graduated during depression years were apparently an outstanding group. That may be chance, or it may be that there is something fundamentally sound in the thought that early and serious attention to the question of finding a satisfactory position develops unusual openings, where opportunities are great and progress rapid.

The program as it is organized this year consists of a series of five general lectures, several departmental meetings, and conferences between the individual students and the departmental placement officers. The general lectures cover problems common to the students of all courses, and the departmental meetings deal with the specific problems of the smaller groups.

Participation in these activities by the students is en-



Technology Review
The Hand of Science

*Paper Presented at the Fifteenth Annual Meeting of the Association of University and College Business Officers of the Eastern States at Pinehurst, North Carolina on December 8, 1934.

Technology Review

The George Eastman Research Laboratories, in which the room shown is in the Organic Section, is supplied with vacuum pumps, thermostats, electric measuring instruments, mercury arcs, hot closets, blast furnaces, equipment for high-vacuum technique, and operations at high temperatures.

tirely voluntary. At the beginning of the session each senior and graduate student is given a placement training card with his registration material, on which he is asked to signify whether or not he plans to participate in placement training during the current year. The attitude of the students toward this program may be judged from the fact that the attendance at the four general lectures, already given this session, has been approximately 90 per cent. of those who were eligible and did not have conflicting programs. The program is carried on by a Placement Training Committee composed of one or more representatives from each educational department, and several ex officio members, such as the placement officer.

The first lecture of the current series consisted of an introduction and a discussion of the student's study of his own qualifications. It was pointed out to the students that the Institute did not guarantee positions to its graduates, nor did it take the responsibility of finding positions for them. It was made clear that proper placement was a problem each individual must solve for himself. It is a co-operative effort in which the faculty contributes much in the way of time and effort to help the students arrive at reasonable solutions of their placement problems.

To acquaint each student with the material he had to work with, the group was told that each should make an analysis of his qualifications. Each one was provided with an outline which would serve as a guide in listing his experience, professional training, extra-curricular activities, hobbies, and vocational preference. The student was then asked to show (1) what knowledge and experience he had which would produce profits for a prospective employer, (2) what he had demonstrated that he could do particularly well, and (3) in which area of business and industry he should seek an opening. This analysis was to be followed by a list of recommendations to himself regarding the things he could do between then and graduation to fit him further for the type of work he wanted. The students were then asked to prepare reports on their qualifications, and submit copies of their self-analyses to their departmental placement officer for use in his discussions with them.

The second lecture was given by the vice-president of one of the large oil companies, on the subject of "Opportunities in Industry." He pointed out the diversity of opportunities in any large organization, and the qualifications necessary for success in the various branches. This lecture was intended to encourage the students to investigate opportunities in fields outside of that in which they had received the major part of their training.

The third lecture was given by the president of a local manufacturing concern, on the subject of "The Employer's Viewpoint." He further stressed the qualifications that were desired in industry, and pointed out some of the more common pitfalls which the students should avoid when interviewing prospective employers, or applying for positions.

The fourth lecture was given by the head of our department of Business and Engineering Administration. He laid particular stress on the fact that the students should begin to establish contacts that will give them first-hand information on the opportunities in different industries. He also stressed the basic principles to be observed in seeking employment.

The fifth and last general lecture in the series will be given by the placement officer. This lecture will deal principally with the operation of the Placement Bureau since this bureau concerns itself with the placement problems of the seniors immediately after graduation.

At each of the general lectures the students are supplied with mimeographed material outlining the principal points covered in the lectures.

The departmental meetings will vary for each department, but they will in general give the students of the respective department an opportunity to hear prominent speakers from the industries employing large numbers of men who have received training similar to theirs.

The general lectures and departmental meetings provide a background for the most important phase of the program, namely, frequent private conferences between the student and his departmental advisor. At these conferences the faculty member studies the student's qualifications and, out of his greater experience and wide knowledge of the professional fields, helps him decide the type of work for which he is best suited. Occasionally a student wants to get into some work that for the moment has caught his fancy. His advisor may show him that he is not qualified and should concentrate on a type of work where his chances of success will be greater.

During the first term of each year, the students who expect to leave the Institute the following summer are given two personnel record forms to fill in and return to their departmental placement officers. One of these remains in the departmental files, and the other is forwarded to the Placement Bureau to serve as the basis for the student's permanent personnel record. The Placement Bureau copy is supplemented by confidential reports from members of the staff who are familiar with the student's personal qualifications, as well as by notes on his interview with the Placement Officer.

At the last general placement lecture the students are invited to arrange for short interviews with the Placement Officer sometime between March 15th and May 15th. The primary purpose of these interviews is to enable the Placement Officer to secure first-hand information on the qualifications and characteristics of each student, so that he will be in a better position to work with him after graduation. Last year we were not able to start these interviews until two weeks before final examinations, but during that period approximately two hundred senior and graduate students accepted the invitation, with the result that summer placements were very much simplified.

Before graduation the student looks to his departmental placement officer for assistance and advice in finding satisfactory work. The Placement Bureau takes over this responsibility after graduation. The Placement Bureau also acts as a clearing house for senior placement information, and arranges for many of the company representatives to interview students previously selected by departmental placement officers.

It is difficult to say just how much has been accomplished by this placement training program, but we think the success of the 1934 graduates in finding satisfactory positions compared with the 1933 graduates is significant—the program was started during the 1932-33 session. As of November 10th only 10.6 per cent. of the men awarded advanced degrees last June, and 22.6 per cent. of those awarded bachelor degrees were unemployed. As of November 10th, 1933, the corresponding figures for the class of 1933 were 24 per cent. and 35 per cent. respectively. In addition to the above improvement in the employment situation, we feel that the large number of complimentary letters received from the 1934 graduates indicates that they appreciate our efforts to get them started satisfactorily after graduation.

The Placement Bureau is maintained by the Institute primarily to assist Technology alumni in securing positions for which they are particularly fitted, and to aid industry in selecting men for positions requiring an engineering or scientific education. For this service there is no charge, either to the alumni or industry.

Many openings for technical graduates are developed through the wide-spread contacts of the Institute. The experience records of the alumni are cross-indexed according to the experience shown on each to aid in filling these openings. If a satisfactory candidate is not found on the available list, no recommendations are made.

By endeavoring to find for industry the best man available for each particular opening, and refusing to make a recommendation if the right man cannot be found, we feel that we are rendering industry a valuable service. The number of repeat calls received from industrial organizations seems to indicate that this service is satisfactory, and that it is an effective method of developing an active demand for our graduates.

THE PRODUCTION OF HELIUM

By EDOUARD R. BOSSANGE, JR. '38
Massachusetts Institute of Technology

HELIUM, though not produced on a large scale today, is important because of the vital part it plays in lighter-than-air aeronautics. Its manufacture has not become a private industry since the gas has but few uses in other fields.

A colorless, odorless gas, helium, next to hydrogen, is the lightest known, and is valuable in aeronautics because it has an ascensional force 92.6 per cent. that of hydrogen. Another important property is that it will not burn. The occurrence of helium in the atmosphere is negligible (1 part in 185,000). It is found to the greatest extent in the natural gas of certain regions.

Helium is found in certain sections of Europe in mineral springs. (See Table I.) Those are the only sources there of the gas, and there is not enough to make its extraction practical for use in lighter-than-air craft. A spring at Mazieres, France, does produce a gas containing about 5 per cent. of helium. A few other springs in the same country yield anywhere from 108 to 1200 cubic feet per year. In Italy helium may be found in small quantities in the volcanic and fumarole gases. Minerals containing thorium, uranium, and beryl also contain it in minute quantities. (See Table II.)

The United States possesses practically all of the helium-containing natural gas. There are also a few wells in Europe. This gas exists in very small amounts in Canada and South America. In this country gas containing 2 per cent. helium may be found in several places. It occurs most abundantly in Kansas. Helium is also found in lesser amounts in Ohio, Kentucky, Omaha, Texas (Petrolia Field), Pennsylvania, New York, West Virginia, Indiana, and Illinois. In these states the natural gas contains from .1 to .3 per cent. of helium.

Prior to 1915 the production of helium in Europe cost about $2000 per cubic foot. Since the War the average cost of 94 per cent. of the helium produced has been 39 cents per cubic foot. The United States Helium Plant at Fort Worth, Texas, started turning out the gas at 8-9 cents per cubic foot and now the cost has been further lowered to 2-2½ cents. The natural gas is brought by a 96-mile line of 10-inch pipe from Petrolia Field to this plant, which is capable of 40,000 cubic feet of helium in 24 hours by compressing 5,500,000 cubic feet of natural gas. (See Table III.)

Two methods of extraction are used for the most part in the United States, namely the Linde and Claude processes. These both depend upon the extraction of other gases from the natural gas by liquefaction through cycles of compression and expansion. The former requires a pressure of about 3000 pounds per square inch, and the latter about 600.

The production of helium by the Linde process is accomplished in two steps. The first yields from the natural gas a mixture containing about 60 per cent. helium, 38 per cent. nitrogen, and 2 per cent. methane. This mixture is known as crude helium. The condensation of the hydrocarbons and some of the nitrogen is accomplished under a pressure of 100 pounds per square inch. The second step by means of liquefaction gives helium about 92-96 per cent. pure.

THE FIRST STAGE: About 40 per cent. of the incoming gas goes directly to the separation apparatus and is given a preliminary cooling. It is then mixed with the other 60 per cent. which has been highly compressed and then allowed to expand. This expansion makes use of the cooling effect of the expanding gas and thus saves in the amount of power needed.

Before the more modern processes were invented the carbon dioxide was removed by a limewater spray. Now the incoming gas is passed through a spray of sodium hydroxide at a pressure of 175 pounds per square inch.

$$2NaOH + CO_2 \longrightarrow Na_2CO_3 + H_2O$$

The concentration of the sodium hydroxide is fixed so that there is no precipitation of sodium carbonate. The spray removes 98 per cent. of the carbon dioxide. The sodium carbonate is reconverted into sodium hydroxide by treatment with milk of lime at a temperature of 80° Fahrenheit. It is needless to point out that this reconversion makes possible a considerable economy. All of the above has to be accomplished before the expansion and compression of the gas takes place. If this were not done, solid carbon dioxide would be formed and the particles would clog the piping.

At this point it would be well to discuss the compressors which play such an important part in the production of helium. After the carbon dioxide has been removed, the gas is passed, at a pressure of 175 pounds per square inch, into compressors which raise the pressure to 2500 pounds. Then it goes through a header system and then to the interchangers of the separation apparatus. The compressors are Worthington-Laidlaw 4 stage, with a 24-inch stroke. The cylinders have diameters of 19, 10½, 7⅛, and 3⅝ inches. Each is run by a 460 H. P. synchronous motor. The displacement is 960 cubic feet per minute at 120

TABLE ONE

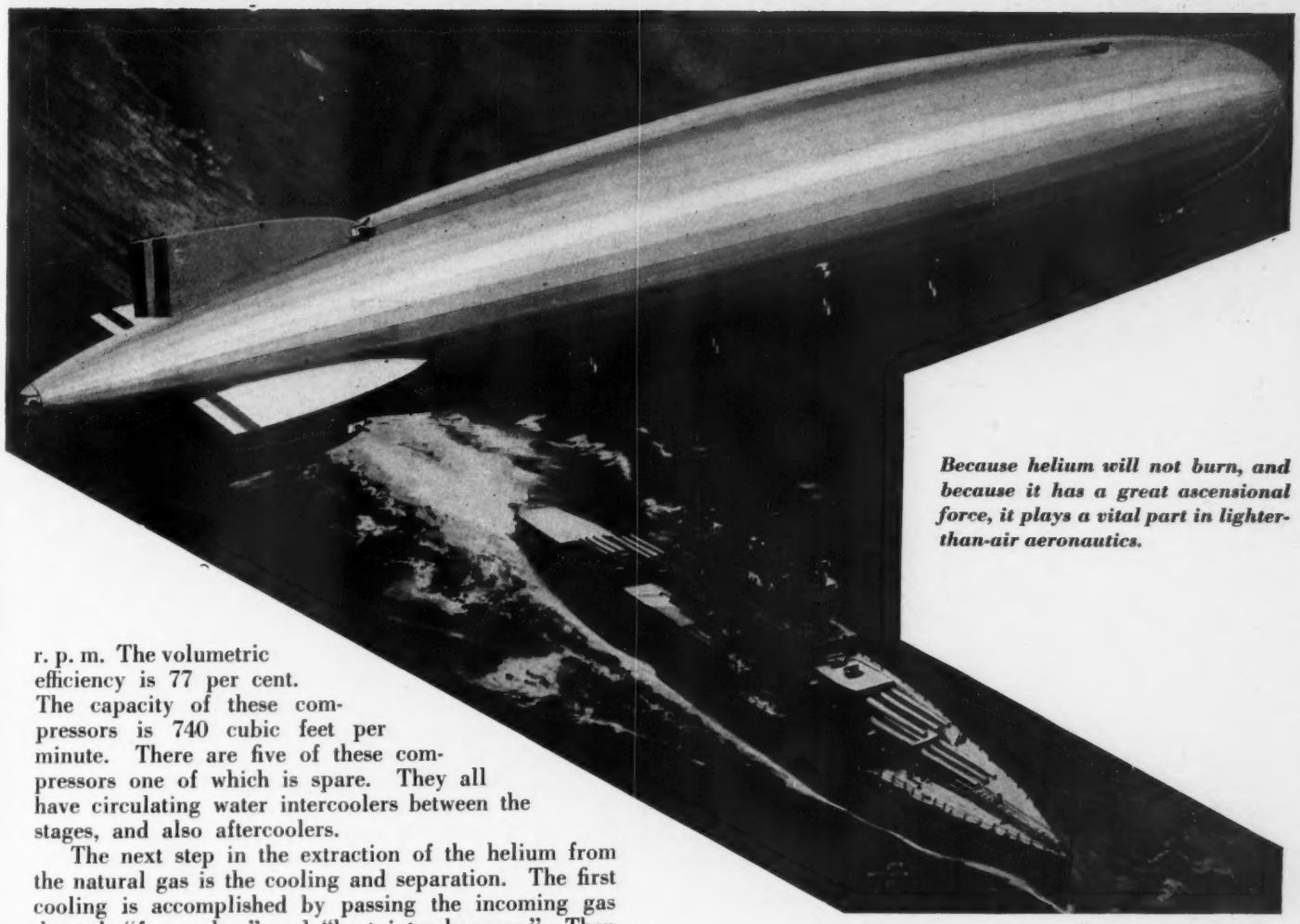
HELIUM OCCURRENCE IN EUROPE

Santenay (Cote d'Or)	183	cubic	feet	per	year
Neris (Allier)	1200	"	"	"	"
Bourbon-Lancy (Saone et Loire)	356	"	"	"	"
La Bourboule (Puy-de-Dome)	108	"	"	"	"

TABLE TWO

HELIUM CONTENT OF MINERALS

Mineral	Helium in c. c. per gram of mineral
Clevite	7.2
Fergusonite	1.1-1.83
Samarskite	1.5
Monazite	2.41
Pitchblende	.107-.30
Thorianite	8.2-8.9



Because helium will not burn, and because it has a great ascensional force, it plays a vital part in lighter-than-air aeronautics.

r. p. m. The volumetric efficiency is 77 per cent. The capacity of these compressors is 740 cubic feet per minute. There are five of these compressors one of which is spare. They all have circulating water intercoolers between the stages, and also aftercoolers.

The next step in the extraction of the helium from the natural gas is the cooling and separation. The first cooling is accomplished by passing the incoming gas through "forecoolers" and "heat interchangers." Then it is finally cooled in "stills." This results in liquefaction. There are six cooling and separation units each consisting of a gas forecooler, a gas interchanger, a nitrogen forecooler, a nitrogen interchanger, and a still. One of these units is spare. The heat insulation is accomplished by the use of horsehair.

In order to attain the necessary low temperature, two closed refrigerating cycles are needed. In one the carbon dioxide is compressed to a pressure of 1900 by 4 Kroeshall refrigerators, one of which is extra. Each one of these refrigerators has a compressor and a double pipe water-cooled condenser. The liquid carbon dioxide produced is then allowed to evaporate, giving the desired cooling effect. Each of these units can give a refrigeration of about 310,000 B. T. U. per hour. The second refrigerating step is a closed nitrogen cycle containing six Worthington-Laidlaw compressors which produce a pressure of 3000 pounds. The nitrogen at a high pressure enters the forecooler in coiled concentric tubes where its temperature is lowered by several applications of cold nitrogen. It then goes through the closed cycle and returns. Further cooling is accomplished by the circulation of cold carbon dioxide. Following this the nitrogen passes through the forecoolers and interchangers where it is again cooled by the nitrogen in the closed cycle. In order to lower the temperature further, the nitrogen is expanded to atmospheric pressure. This expansion gives a temperature of 190° C. and the crude helium is cooled by the nitrogen at this temperature. The nitrogen finally goes to a 10,000 cubic foot tank that supplies the nitrogen compressors for the closed cycle. Before it goes into this tank, however, the gas is passed through the interchanger and forecooler from which it absorbs heat.

As has been mentioned before, the cooling and separation apparatus consists of three units. The first of these is the gas forecooler. In this the gas passes into concentric tubes which are exposed to the returning waste gases (including nitrogen) from the interchanger. Then it is cooled by cold carbon dioxide from the external cycle. The second unit is the gas interchanger. The high and low pressure gases go through this separately after leaving the forecooler. They are cooled by the waste gases first and then by the waste nitrogen from the still. The respective pressures then are 2500 and 100 pounds per square inch. After leaving the interchanger the high pressure gas is cooled still more when it is allowed to expand to a pressure of 100 pounds. The high and low pressure gases are then mixed and led to the third unit, namely the still.

(Continued on page 157)

TABLE THREE

A Typical Analysis of Petrolia Gas

	Per Cent.
Helium	.93
Carbon Dioxide	.25
Oxygen	.54
Methane	56.85
Ethane and Heavier Hydrocarbons	10.30
Nitrogen	31.13
	100.00

THE FLIVVER PLANE—

Will It Ever Come of Age?

By O. C. KOPPEN
Associate Professor of Aeronautical Engineering
Massachusetts Institute of Technology

THAT the long sought public support of aviation is slowly beginning to materialize is becoming apparent to even the casual observer. This trend is definitely shown by the general acceptance of travel on transport lines and by the increasing business of the manufacturers of relatively inexpensive airplanes. Moreover, the entire aspect of the latter type of business appears to be changing rapidly. Until a short time ago small airplanes were sold chiefly to commercial operators who used them for flight instruction and miscellaneous flying. The airplane manufacturer had very little contact with the ultimate consumer and practically all of his income was obtained indirectly through the professional airplane operator. Consequently airplane design trend was directed toward filling the needs of the commercial operator.

The direct sale of airplanes to the consumer is bound to have a drastic effect upon airplane design requirements. The new demand will shift airplane design emphasis in the direction of making flying easier and less hazardous. The airplane designer, however, is in a poor position to meet any such new requirements; design methods dealing with flying characteristics have improved little since the early days of aviation, and it is likely that modern designers pay less attention to the characteristics that affect the skill required to fly an airplane than did the Wright brothers. The happy circumstance that anything which remotely resembles an airplane will fly satisfactorily in the hands of a skillful pilot has halted progress in that field of design. That the skill required to fly an airplane is expected to be of a high order is shown by the existing high accident rate in spite of careful training and selection of pilots. No such high level of skill and physical fitness could be expected of the average private owner.

The trend of airplane design has been distinctly in the direction of making flying more difficult. In prewar days it was not considered unusual for a student to fly solo after less than one hour of instruction and at least one case is on record in which a student not only flew solo but was able to pass the flying tests required for a license in one day. Furthermore, the tests were not far different from those now required for a private license.

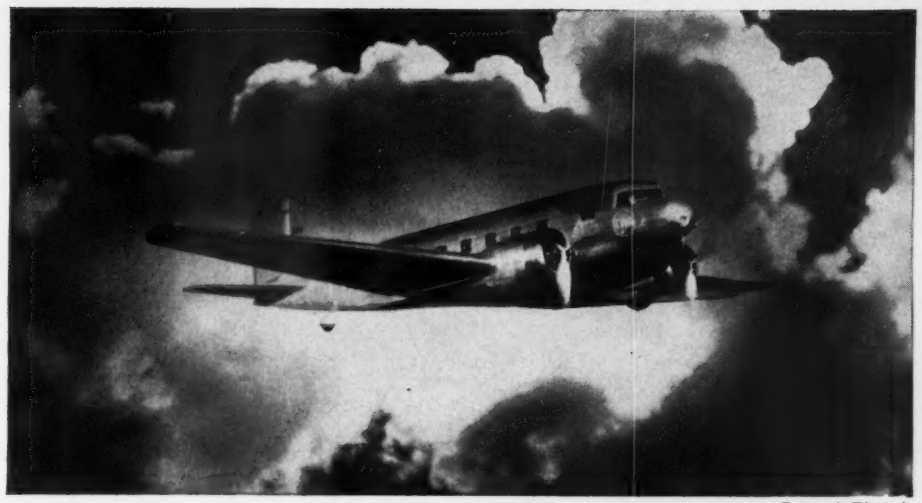
The relatively greater difficulty of flying modern airplanes does not indicate that the present day designer knows less than his predecessor. On the contrary, the ease of flying the early airplanes came about in a purely accidental manner. It can be shown that the degree of skill required to fly an airplane is a function of the ratio of the load per square foot of wing area to the size of the airplane. In order to fly at all with the engines then available the wing loadings of the early airplanes were necessarily low. The low wing loading required had the additional effect of increasing the size of the airplane. Consequently the average values of the ratio of the wing loading to size were about one tenth those of modern sport planes.

To easily meet the demand for an airplane that is easy to fly, it is always possible to revert to the earlier types. Moreover, there has been a strong tendency to do so whenever an airplane for the amateur pilot was required. However, Anthony Fokker summarized the advantages of that type of flying during a lecture to the Technology Aeronautical Engineering Society several years ago in a way that cannot be improved upon. His statement was to the effect that if your purpose is merely to go up and look around, the thing to do is to build a tower. The airplane is essentially a long range vehicle. Any attempt to use it otherwise is defeated by the inaccessibility of airports. The ever present possibility of engine failure on the take-off precludes the solution of operating from small prepared areas within cities. Even one forced landing in a crowded street per thousand take-offs would be too many.

If the airplane is to be used for long trips, it must be fast. In addition to the advantage of making long trips possible, a fast airplane is useful in "sneaking through" before threatening

Aero Digest

Previous models of the Auto-Gyro had short, stubby wings. This new model has no wings at all. Perhaps the Auto-Gyro will eventually solve the private flying problem.



General Electric

An apt example of what Rupert Brooke called the "keen impassioned beauty of a great machine." Embodiment of lightness, strength, fleetness, beauty is the Douglas Transport.

weather completely closes in; it is more comfortable than a slow airplane in rough air, and a head wind has a relatively smaller effect upon its ability to cover ground. In order to be fast and economical the load carried per square foot must be high. Consequently the airplane will be small. If the usual design procedure is followed, the high wing loading combined with small size will provide tricky flying characteristics. Only an expert pilot could be expected to fly an airplane of this type with a reasonable degree of safety.

The reaction of the airplane industry to this situation is to call for better pilots. The chief markets of the industry have always been able and willing to supply the grade of pilot required as airplane design "progressed." This condition does not apply in private flying. The expense of learning to fly is a definite drawback to the purchase of an airplane; the nuisance of learning to fly is even a worse stumbling block. Moreover, if such an airplane is to be flown successfully over long periods of time, the owner must practice flying constantly whether he wants to fly or not. That the use of private airplanes cannot increase rapidly under the present circumstances should be clear to the most rabid enthusiast of flying. If there is some other solution of the problem than to increase the average level of flying technique, that solution must occur during the design of the airplane. And it is not likely that the problem will be solved if the present design methods continue. Very little attention is now paid to the airplane features that affect the flying characteristics. In fact, very little is known about them. The engineer's contribution to the advance of aviation has been in the design of the airplane structure and to a lesser extent in the estimation of the probable performance of the airplane. The part of the design procedure that fixes the flying characteristics is considered an art and as such is carefully avoided by the engineer. Consequently the former airplane mechanic or pilot who has what is considered a "good eye" for an airplane is usually a better designer than the trained engineer. The engineer's job then is reduced to building a safe structure into what is considered to be a good looking airplane.

Under the circumstances it might be expected that

(Continued on page 156)

Right—A controllable pitch propeller.
Below - Small, fast fighting planes require expert flying ability.

Technology Review

Filters for

COLOR CORRECTION

in Photography

By FRANK B. KEMP '38
Massachusetts Institute of Technology

FILTERS are used in photography for many reasons, but the most important is to correct the discrepancy which exists between the effect which colored light has on the eye and that which it has on the photographic plate. Ordinary film is most sensitive to light in the violet and ultra-violet region of the spectrum, while the eye's sensitivity is greatest in the yellow-green region, a portion of the spectrum to which ordinary film is absolutely insensitive. Now obviously, no filter when used with this film will produce a color corrected photograph.

In 1873 Vogel found that by being treated with certain dyes the plates could be given, besides their usual sensitivity, a secondary sensitivity in that region of the spectrum which those dyes absorb. It was discovered that by being treated with an erythrosine solution, which is a dye that absorbs yellow-green, plates will be made sensitive not only to blue and ultra-violet, but also to the yellow-green parts of the spectrum. Plates and films so treated are termed "orthochromatic," although this is obviously a misnomer, as the plates are not sensitive to all colors. Although this film is an improvement over the ordinary film, still, its sensitivity can not be compared with the sensitivity of the eye. Orthochromatic material has an enormous excess of sensitivity in the violet and blue; it has sensitivity in the ultra-violet, which the eye has not at all; and it is insensitive to the red. It has only secondary sensitivity in the yellow-green, whereas the eye has maximum sensitivity in that region. Nevertheless, orthochromatic film and plates are very useful, especially if filters are used to cut out the excess blue and ultra-violet. The various "chrome" type films are excellent examples of orthochromatic materials which give satisfactory results in photographic practice. These films make possible a much more truthful rendering of green and yellow objects than can be secured with the use of ordinary film.

Early in the twentieth century new sensitizing dyes were discovered which made it possible to prepare photographic materials sensitive to the whole visible spectrum, including the red. This type of film or plate is termed "panchromatic." Since 1912 the use of these materials has increased rapidly. This type of plate or film, however, still retains an excess of sensitivity in the blue and ultra-violet regions. By the use of correct filters, correct color rendition can be obtained from these films, but the time of exposure must then be increased markedly.

In 1930, entirely new sensitizing dyes were discovered by the Kodak Research Laboratories which made it possible to produce material of far greater general speed and color sensitiveness than anything previously known. These materials are classified into two classes: the orthopanchromatic, and the hyperpanchromatic. The orthopanchromatic materials are especially useful for the photography of colored objects and are intended to be used with filters. The filters are necessary because even this material is excessively sensitive to the blue and ultra-violet. However, filters, when used with orthopanchromatic materials require only a moderate increase in exposure as compared with the strictly panchromatic emulsions. The hyperpanchromatic films and plates are intended for use where the shortest possible exposure is required. Filters may also be used with them but require greater filter factors.

Thus, it may be seen that by the use of any of the panchromatic materials, any scene or object may be photographed so that every color is given its correct value in monochrome, but in order to do so a filter must be placed in front or in back of the lens so that the blue and ultra-violet will not produce an undue effect upon the plate.

This filter must be accurately adjusted to the sensitive material. It must be sufficiently dark to stop the correct proportion of blue and violet, and especially it must stop all the invisible but very active ultra-violet light. But it must not absorb too much blue or all the violet, because if it does these colors will be reproduced too darkly. If orthopanchromatic or hyperpanchromatic materials are being used, the filter must also cut out some of the red, as these materials have a slight excess of sensitivity to that color. Filters such as these, which are used to secure correct color rendition, are called "orthochromatic" filters.

For orthochromatic work, all filters which are not a clear yellow should be discarded. They should under no circumstances appear brown. Although a brownish filter may produce a color-corrected photograph, it will require an unnecessarily long exposure. In most cases, however, brownish filters produce unsatisfactory color correction.

It has been shown that photographic materials are extremely sensitive to ultra-violet light. When Professor R. W. Wood took photographs by means of ultra-violet light only, using a special lens and filter, he found that if one could see the rays he was photographing even the clear air of the United States would seem to be continually filled with mist, because of the fact that ultra-violet light is much more easily scattered by traces of mist in the air than is visible light. Therefore, the well known photographic haze, which so often spoils the distance in photographs, is due to the ultra-violet light. The orthochromatic filter must be adjusted to cut out completely the ultra-violet and admit just so much of the violet light as is necessary to produce that effect of atmosphere as is recorded by the eye. If too much violet is cut out, the photograph is said to be "over-corrected."

The dyes which were originally used in the making of orthochromatic filters, while being of a pure yellow color, permitted a great deal of ultra-violet to pass unless they were of a very deep shade of yellow. As this made longer exposures necessary, these filters were usually considered inefficient. Recently, however, new dyes have made possible the preparation of orthochromatic filters of almost ideal efficiency.

Since the use of a filter is to compensate for the excess of sensitivity of even orthochromatic and pan-

chromatic materials to the violet and ultra-violet, it follows that materials of different degrees of sensitivity will require different filters in order to produce color corrected images. The kind of filter to be used depends not only upon the sensitive material, but also upon the nature of the source of light. This discussion will limit itself, for the present, to photographs taken in natural sunlight.

With orthopanchromatic materials, full correction for sunlight is obtained by the use of the yellow K2 filter. The extreme sensitiveness to red of the hyperpanchromatic stock necessitates the use of a filter which will absorb a little red in addition to the ultra-violet and violet. For color correction with this material the yellow-green X1 filter must be used. Although full color correction obviously can not be obtained from a red-blind non-panchromatic emulsion, the use of a light yellow filter, such as the K1, which removes a great deal of the violet, and all of the ultra-violet, materially improves photographs taken on such material.

There are occasions in landscape or survey work, when it is desirable to remove a great deal of the atmospheric haze. To do this a strong yellow G filter, which cuts out all the violet, as well as the ultra-violet, is used. This filter produces what is technically known as an "over-corrected" photograph. To remove atmospheric haze completely, and to take photographs over great distances, use is made of the invisible infra-red light. However, infra-red technique involves the use of special infra-red sensitive plates, and often of visually opaque filters. It is possible, though, to use some infra-red material with the ordinary red A filter. Infra-red photographs always produce considerable color distortion, although they show sharp detail in distant objects. The red A filter is also useful, when used with ordinary panchromatic materials, in making pictures of clouds against a blue sky. The resulting photograph usually shows white clouds standing out from a black sky. This exaggerated contrast is useful in the study of cloud formations, but cannot be recommended for pictorial work in which correct color rendition is of prime importance.

Contrast filters differ from orthocromatic filters in that it is not desired to obtain from them a gradual increase in absorption, but as sharp a transition as possible between the region of absorption and the region of transmisison. For instance, the red A filter cuts sharply in the orange region of the spectrum, transmitting freely all the longer wavelengths, but absorbing completely the shorter ones. The strong yellow G filter absorbs all the light of a shorter wavelength than the blue-green, and transmits the rest. Both these filters are classified as contrast filters. The one thing to be remembered in photographing for contrast is that in order to render a color black, a filter which absorbs that color must be used. For instance, in photographing red flowers in a field of wheat, if orthopanchromatic material is used with a K2 filter, the color correction will be perfect. But as the luminosity value of both the flowers and the wheat is about the same in their respective colors, both will register as a gray of the same intensity on the resulting print. Therefore it will be necessary to over-correct, slightly, one or the other. As the eye is more sensitive to red than to yellow, it would be advisable to over-correct the red, that is, render the red darker than its true value, so that the flowers will stand out against the field of wheat.

In the early days of photography almost the only source of light available was the sun. Daylight, however, is from many points of view inconvenient. Not only does it vary in intensity and quality throughout the day, but it also varies in those qualities from season to season throughout the year. Consequently, getting the correct exposure, even in these days of film with enormous latitude, is often a difficult task. Artificial light, on the other hand, is constant in color and intensity. Besides being under constant control, it is available whenever desired.

Common electric light sources are divided into three classes. They are high efficiency tungsten lamps, arc lamps, and gaseous conductor lamps. Tungsten lamps are being used more and more because the newer panchromatic emulsions are very sensitive to light produced by such lamps. Furthermore, tungsten lamps are much more convenient than any of the other kinds. Arc lamps are particularly useful in photo-engraving shops, where ultra-violet emulsions are generally employed. The gaseous conductor type of illumination, of which the mercury vapor tube is the most common example, has fallen into disuse with the introduction of the newer red-sensitive emulsions. The hyperpanchromatic materials, which have a high total sensitiveness and extreme sensitiveness in the red portion of the spectrum, are particularly suitable for use with tungsten lamps or panchromatic carbons. For satisfactory color rendition a deep yellow-green X2 filter must be used. When filters are used the exposure must be increased, but the increase is greater with panchromatic arcs than it is with tungsten.

Contrast filters can be used with artificial light in the same manner as with daylight, and the increase in exposure will vary with the different filters and with the quality of light used. Filter exposure factors for a particular film are usually packed in the film package. Of course full color correction can not be obtained with artificial light if the light source is deficient in any of the visible frequencies.

From the foregoing it may be seen that color filters and color sensitive films may be used advantageously in photography with either artificial or natural light. Although the photographic technique is somewhat different for each division, the equipment is almost identical.

Photo by F. C. Bowditch *The American Annual of Photography, 1935*

Picture taken of Mount Monadnock, sixty miles away, by means of infra-red light.

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EDITORIALS

A LIBERAL EDUCATION

MR. NALLE in his article which appears in this issue points out the gratifying success which his bureau has achieved in aiding the members of the recent graduating classes to find employment. High credit for such an outstanding accomplishment must be given to the placement bureau which has based its work on sound fundamental principles, and has kept its methods and details practical and workable. It is an excellent example of intelligent application of engineering methods to a most difficult problem of personnel.

But it must be remembered that the placement bureau had a magnificent groundwork upon which to build, in the outstanding character and accomplishments of the great body of M.I.T. alumni, and the bureau would be the first to acknowledge this. M.I.T. graduates have demonstrated their ability to understand the spirit and the problems of their generation, and to a remarkable extent have been able to fit in and play their part in the world's activities. Science and engineering have, decade after decade, gradually changed over our civilization until now we are in the midst of "the machine age." The major content of the body of knowledge of the modern world is scientific. The present-day method of doing things is engineering, and the spirit of the times is highly idealistic. The scientific and engineering educational plan of M.I.T. has for its main stems science and engineering, but they are buttressed and supported by history, literature, economics and social studies. Its older graduates have played a prominent part in building the present civilization, and it is no wonder that industry today has confidence in the ability of the younger graduates to carry on with the same understanding of today's problems that their predecessors showed of the problems of their time.

This brings us to the point we wished to make. If the correct definition of a liberal education is "that education which enables a man best to understand the spirit and problems of his own generation, and best to fit in and play his part in his own era," isn't a scientific and engineering education, like that acquired at M.I.T., the truly liberal education of today, the classicists with all their Latin and Greek to the contrary?

WILLIAM H. TIMBIE,
Professor of Electrical Engineering
and Industrial Practice.

ELECTIONS

WITH this last issue of Volume XV it is again time for an old Managing Board of THE TECH ENGINEERING NEWS to step aside for their successors. Elections have been made, and with the next issue the magazine will be under new management.

The Senior Board of Volume XVI will be Dorian Shainin '36, General Manager; Brenton W. Lowe '36, Editor-in-Chief; and Robert E. Williams, Jr. '36, Business Manager. Comprising the Junior Board will be Paul Allen '37, Associate Editor; Herbert Zimmerman '37, Advertising Manager; Francis Buffington '37, Treasurer; and John Robbins, Jr. '37, Circulation Manager. In addition Walter H. Schwedes '37 was elected Publicity Manager.

To this new board the outgoing Managing Board of Volume XV wishes every success.

THE NATIONAL RESEARCH COUNCIL

AN indication of the modern methods of research is shown in a summary report of the work of the National Research Council for 1933-1934. This group functions so that science may advance over the widest area, in the straightest line. They supply the initiative for opening up a lagging field. At present they are seeking to promote research in the relatively new fields, biochemistry and biophysics. The Council awards fellowships to promising men and women who have taken their doctor's degree, in an effort to give the talented person the greatest opportunity in the fields of pure science, medicine and biology. Other funds are given for the support of scientific investigation; the Rockefeller Foundation has given over $370,000. Technology students can not help but realize the importance of such work and admire the ardor with which it is pursued by the men here at the Institute.

Two major undertakings in the Division of Medical Science have been studies of drug addiction and sex research. That such research is vitally necessary is shown by the wretched conditions that exist in some of our cities. Contributions have also been made to psychiatry from the semi-scientific fields. The Council fostered improvements, the most notable of which is the improved technique in welding. One should give credit to the engineer, who works collaterally with the inventor and develops his inventions; his work is not so spectacular but it is just as valuable.

The National Research Council was created in 1918 by an executive order. Only recently President Roosevelt created the Science Advisory Board to co-operate with the Council. Thus the government avails itself of the most brilliant scientific minds in solving its problems.

The National Research Council is a member of the International Sciences Union, under whose auspices scientific congresses are held, and which exists to improve the relations of foreign scientists. Since it is made up of the science unions of various countries, it is in a position to assist the exchange of results between professional men and thus obviate the duplication of work.

Is not this stage of development worthy of remark and commendation? The State has ceased to consist of isolated groups, working separately, and has acquired an organization, which represents it nationally and internationally. Today, Morse's efforts for recognition of his telegraph would have been answered, and DeForest and Fleming would not have duplicated each other's work so closely. But most notable of all is the fact that science is in a position, as it never has been in before, to concentrate and direct its efforts unhampered.

IS IT WORTH IT?

THERE is much difference of opinion upon the actual values of an engineering education. Surveys have shown that the engineering student does twenty per cent. more work than the average liberal arts student, and is often so hard pushed that he has no opportunity to assimilate what little liberal arts education with which he comes into contact. However, from an engineering viewpoint, broader training does not necessarily mean liberal arts, but refers to anything which will develop a man (as far his his grey matter will permit), capable of leading a more successful life, and particularly capable of deriving the greatest enjoyment from living. The conflict about the obtainable benefits during the span of a lifetime from both liberal arts and engineering methods of education may best be explained from a consideration of men's beliefs as to what is true success.

Proponents of engineering education look for men who make their contribution to the world (perhaps unknowingly) by solving the little problems which they face. Only if each man adds his one or two bricks to the foundation, can a civilization be built and the faults in its structure remedied. To carry out their beliefs, they want men who know how to do constructive work thoroughly and rapidly. A man, they say, who is to fill such positions must know how to attack a problem, *i.e.*, analyze it completely to the necessary degree, draw the necessary conclusions, and then proceed to apply this. No matter what the size of the problem is, the method of devising action is the same. True, problems are usually so small that the method is used unconsciously and it is especially for these small problems that the proponents of engineering education advocate the courses which develop the individual in a logical direction. They claim that scientific training, advanced by theory and supplemented by laboratory applications produces a logical mind which functions naturally after their prescribed method of attack, and is, therefore, in the end more satisfactory. To refute an argument that their idea of training is apt to give little satisfaction and pleasure to the individual, they can cite more examples of people interested in phases of science and little details of practical executions produced by a scientific frame of mind than their opponents can of genuine interest in the finer things of life inspired by a liberal arts education.

On the other hand, people who propose a more liberal education reflect a desire for ease and simple grace in living. They do not look for a Utopia in which everyone lives under the optimum physical conditions, but rather for a world where everyone can be himself. They often go so far as to bewail the distractions modern civilization makes on individualism, declaring it turns out nothing but cogs, enjoying life in a superficial way. They point to liberal education as the method to develop poise, control, and above all happiness. They do not advocate a method, a theory, or a technical skill to be used as tools to get ahead, but only a subconscious background which gives a man some substance—a thrill in living and a feeling of its philosophy. This breath, they say, is the most important thing in life.

(Continued on page 157)

ENGINEERING DIGEST

TOUGH GLASS

A FEW months ago, certain members of the laboratory staff of a well-known optical company amused themselves and visitors by tossing glass lenses on a concrete floor. The height of the drop varied from four to ten feet, and yet not a single lens was broken. These lenses were not laminated or reinforced by wires or any other mechanical means. They were perfectly clear, as they were made for optical use. Although they can be and have been broken, it is estimated that they require a blow thirteen times as great as that necessary to break an ordinary lens of the same dimensions. Moreover, when this glass does break, the pieces are small and have rounded edges, instead of the relatively large, razor-edged splinters which ordinary glass forms.

The "tough glass" is made contrary to traditional "good factory practice," which requires that glass be annealed, that is, cooled slowly from the molten condition, to minimize the formation of strain. In the process used to make the new type of glass, the procedure is reversed. The glass is heated to the softening point, about 1500° F., and this quickly cooled by means of an air jet, steam jet, or immersion in oil at approximately 400° F. The result is that the exterior layer of the glass is quickly solidified, while the interior, cooling at a slower rate, contracts and places compressive forces on the exterior. The interior is put under very strong opposite but equal tensions, a fact which polarized light reveals. In this way, instead of avoiding strains as in the old art, strains are intensified, but their direction controlled to obtain symmetrical stresses.

The first commercial application of toughened glass of this type was in the manufacture of industrial goggles. Although ordinary glass lens furnished protection to the eye against flying particles of metal, stone, and similar objects, they created secondary hazards in the form of sharp-cutting splinters, when shattered. On the contrary, tough glass lenses resist breakage to a far greater degree, and when broken do no cutting.

The new glasses are not restricted to industrial goggles. They are employed successfully for correcting defective vision, and make the frame, rather than the more expensive lenses, the more delicate portion of eyeglasses. The only restriction to the use of such lenses is their thickness; they must be over three millimeters thick to retain their characteristic features. The disadvantages of a thick lens in some extreme cases is offset by the protection against breakage.

The superior toughness of this glass makes its use advantageous in several branches of industry, such as in gauge glasses for steam boilers, in lamp chimneys, porthole glass, and the like.

In automobiles, tough glass may be used for windshields. Because of its superior resistance to mechanical shock and its non-formation of cutting splinters, a single sheet may replace the ordinary laminated, or "safety," glass. Although lamination prevents the flying of splinters, the thinner sheets so joined together are easier to break than a single sheet of equal thickness.

With such an important physical property, tough glass deserves further study. Its use may be found to be superior in many more branches of industry. (*Industrial Bulletin,* Nov., 1934)—JAMES HESS.

NEW FEATURES OF RADIO SETS

THE mechanical engineer should take more share of praise in the recent developments of the radio. Their discovery that the r-f amplifier could be switched from one band of coils to another, each covering a distinct and perhaps restricted range of channels at once made possible truly all-wave sets. Proper assembly of coils, selector switches for connection of three sets of coils for each band covered, shielding developments and keeping electrical fields where they belong have required consistent mechanical ingenuity. Neat mechanical designs have made possible the ways of changing the vernier ratio of the tuning dial on the Philco and RCA Victor sets. Backlashing and lost motion in transmitting the motion of the tuning knob to the variable condensers are no longer important problems.

The introduction of Atwater Kent's Tune-O-Matic model is being watched with considerable interest as a trend. In the tuning motor of this receiver, the direction of rotation is constant, *i.e.*, the shaft does not reverse in order to move the variable condensers in the opposite direction. The motor shaft runs between two rubber-tired wheels, one large and one small. Normally the shaft rests against the small wheel. The resulting motion drives the condensers in the direction of 540 to 1600 k. c. The motor is pivoted so that it can be tipped, and when so moved it rests against the larger wheel which rotates the condenser in the opposite direction.

The process of tuning in a station is as follows: suppose the set is cold and that 3:00 p. m. is the time chosen by the owner to listen to some particular program. At this time, the electric circuit to the motor and to the solenoid (which tips the motor from the small to the large wheel) is completed. The solenoid tips the motor to the large wheel. The variable condenser is turned to the frequency of the desired station. When this point is reached, a high impedance relay is cut into the motor circuit forcing the motor to stop; then the solenoid throws the motor so that its shaft is braked by the small wheel. By this time the relay has connected the 110 volt circuit through the receiver so that the tubes have warmed up and set is ready to function. The eight selector disc is the "f" disc, and thus if the owner wishes the set to be shut off at 3:15, he plugs the "off" disc into the 3:15 jack so that the receiver is automatically turned to the 1600 k. c. position where it is automatically shut off. Current is taken by the set only when in operation except that required by the electric clock.

The prepondrance of the airplane tuning dial was noticeable at the Madison Square Garden show of September. With the average-sized dial, the scale length is small compared to that possible with the horizontal hand type. This is overcome, however, by the use of a second hand on the airplane type dial which travels at a lower speed. (*Electronics*, November, 1934.)—J. C. W.

RESEARCH IN REVIEW

COURSE I — Civil Engineering

DR. WILBUR has designed a machine for solving linear simultaneous equations and is now supervising the construction of a unit to handle up to ten unknowns.

At the Annual Meeting of the Highway Research Board in December, Professor Breed presented a progress report discussing in particular the changes in road costs on Route 12 in Worcester County due to extensive reconstruction on that route.

The Civil Engineering laboratories are being equipped for fundamental research in the field of cement and concrete. Rooms controlled as to temperature and humidity are being constructed for storing specimens; apparatus for measuring hygral and thermal volume changes has been obtained; and apparatus for measuring heat generation of cement during hardening has been constructed. The new equipment, together with that already on hand, will make possible studies of practically all the important properties of cement and concrete.

COURSE III — Mining and Metallurgy

THE research program in the Division of Physical Metallurgy is continuing along much the same lines indicated in an earlier report. Professor Homerberg with his graduate students is studying the nitriding characteristics of gray cast iron, malleable iron and a steel with low aluminum content. A group under Prof. John Norton's direction is studying the phenomenon of age hardening in a number of alloys by means of the X-ray. Professor Zavarine is determining the relation between magnetic and phase transformations in steel in the sub-critical range. Phase changes are being followed by X-ray measurements during the quenching operation. In connection with Professor Edgerton, Professor Zavarine is also studying the mechanism of quenching by means of high speed photographs both still and moving. Mr. Hentschel is investigating the distribution of non-metallic material in steel with regard to the sizes and amounts of the particles. This involves an electrochemical separation followed by a division into size groups by an air separator based on Stokes' law. The results of this investigation will be correlated with certain dynamic properties of steel. Mr. Long is studying the influence of high frequency vibrations on diffusion processes in metals. The diffusion rate which is believed to increase with vibration is being studied with nitrogen, carbon and certain electroplated metals.

COURSE V — Chemistry

IN addition to the inorganic research problems mentioned in the TECH ENGINEERING NEWS for December, 1934, the following subjects are being studied at present in the Research Laboratory of Inorganic Chemistry.

The effect of the electrodeless discharge upon reactions between gaseous substances at low pressure is being investigated, the synthesis and dissociation of ammonia being given particular attention at this time, with the objective of applying this technique to the bringing about of various other reactions between gases which normally are possible only under conditions of elevated temperature or of high pressure, or both.

With the help of a new magneto-striction oscillator and amplifer, the investigation by Professor Shumb of the influence of sonic and ultrasonic vibrations upon chemical changes is under way in this laboratory. The apparatus makes it possible to study the frequency range of from 10 to 600 kilocycles and it is proposed to study the effect of intense sound energy over this range upon a variety of oxidation-reduction reactions, as well as intra-molecular changes in both inorganic and organic substances.

The organo-metallic compounds of indium are being studied, as well as the analytical methods of determination of zirconium and selenium. Professor Blanchard continues his investigations of the carbonyls and nitroso-carbonyls of metals.

In the elaboration of the chemistry of silicon, especially of the halides of silicon, the methods of preparation and the properties of silico-iodoform and of the fluoro-halides of silicon are being studied.

COURSE XVIII — Mathematics

ONE of the many problems under investigation in the Mathematics Department deals with a molecular motion in which temperature has different values in different directions. Under ordinary conditions the random motion of the molecules of a gas is the same in all directions, and is represented by a singlge number, the "temperature." In certain problems, however, such as the evaporation of a liquid into an evacuated space, or condensing chamber, this random molecular motion is no longer independent of direction; and any attempt to solve such a problem by means of the usual concept of a gas having a single temperature leads to an immediate contradiction.

By using two "temperatures" instead of one to define the random motion of the molecules, Dr. Crout takes into account this dependence of motion upon direction, and problems of the above type can be solved. In the immediate vicinity of the liquid, however, one cannot speak of the "temperature" of the gas, but must speak of the "longitudinal temperature" in the direction of evaporation, and the "transverse temperature" at right angles to this direction. These two temperatures are equal only when no liquid is evaporating; otherwise the transverse temperature may be as much as 5 per cent. higher than the temperature of the liquid, and the "longitudinal temperature" as much as 45 per cent. lower than the liquid temperature. As the rate of evaporation is increased from zero, the pressure on the liquid surface may drop 45 per cent. below the saturation vapor pressure.

At present the numerical work involved in the above problem is being carried out. and other problems of gas flow are being investigated.

THE FLIVVER PLANE

(Continued from page 149)

airplane flying characteristics will vary widely and that in the normal course of events some airplanes will be much better than others. The most surprising part of the situation is the unanimity of pilot's opinions when an exceptional airplane is produced. However, there have been less than half a dozen of such airplane types designed in the last fifteen years and the sad feature of the situation is that all efforts to discover the particular characteristics that make an airplane exceptional have so far proven unsuccessful. Even when all the tools of scientific research are used, no reason can be found to explain the relative excellence of certain types. The problem is like that of finding a needle in a haystack with the additional complication of not knowing what the needle looks like.

There is no question but that airplane design procedure must be reduced to engineering methods before much progress may be expected. An airplane differs from other vehicles in that its form not only determines its appearance but also its motion. Although in general a sound engineering job is usually good looking, the converse is not true; a good looking job may not satisfy fundamental engineering requirements. Consequently more research is needed to establish the important quantities and to reduce them to numerical calculation.

The airplane industry does not appear to be aware of the changing aspects of its market. However, in the long run, the consumer usually gets what he is willing to pay for, and the present lack of importance attached to the skill required to fly is bound to disappear. There appears to be no basic reason why an airplane cannot be built that is capable of a cruising speed of 150 miles per hour and which, at the same time, can be flown solo after two hours of instruction. Moreover, there is no reason why the accident record of such a machine in the hands of the amateur pilot should be worse than the present transport rate which amounts to about one fatality per 50,000 hours of flying.

An airplane having these characteristics could really justify its existence. This is more than can be said for most private airplanes that are flown chiefly by enthusiasts for the fun of flying. The high cruising speed will enable the owner to cover in a given time about five times as much ground as he can at present by car. Although most people do not appear to have any immediate desire to increase their radius of action, experience with other forms of transport has shown the ready acceptance of a more rapid means of travel. Moreover, there can be no question but that the availability of a new form of transportation usually changes the nation's travel habits and, in some cases, its mode of living.

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THE PRODUCTION OF HELIUM

(Continued from page 147)

This consists of three parts. In the first and lower one liquefied waste gases, surrounding vertical tubes containing the incoming gas, condense the lower hydrocarbons (including the ethane and a part of the methane). In the same manner the remainder of the methane is condensed in the middle unit. The helium and nitrogen which are left enter the upper section where the latter condenses at -190° C. and at a pressure of 90 pounds per square inch.

THE SECOND STAGE: The first stage yields crude helium. This, as has been mentioned before, is a mixture containing about 60 per cent. helium, 38 per cent. nitrogen, and 2 per cent. methane. Since the amount of methane is negligible, it is only necessary to separate the nitrogen from helium. For this reason the still for the second stage needs only one unit. The crude helium is metered before being purified. The temperature of the gas as it leaves the first stage is so low that it would freeze the meter. Therefore, it is warmed by subjecting it to the incoming low pressure gas in concentric coils. These are in six interchangers. Then the crude helium is led into Norwalk compressors which raise its pressure to 600 pounds per square inch. These compressors have an 8-inch stroke, and cylinder diameters of 7½, 6¼, and 4 inches. They are driven at 160 r. p. m. by Lenix drive motors of 35 H. P. Their volumetric efficiency is 70 per cent. Each unit has a built-in aftercooler to remove the heat of compression. At the above pressure the gas enters the forecooler where it is cooled by cold pure helium and the waste nitrogen from the still. Following this cooling it enters the interchanger in concentric coils and its temperature is further lowered by contact with the same gases. In the still the nitrogen is liquefied by the nitrogen in the external cycle. The pure helium is next metered and led to a 5000 cubic foot tank. For transportation it is taken and compressed into cylinders. This compression is done by two Nordberg compressors, vertical type. Each can compress 5000 cubic feet per hour, and can yield a pressure of 2500 pounds per square inch. They operate at 105 r. p. m., with a 9-inch stroke, and have cylinder diameters of 12¾, 9¼, 4⅞, and 2⅜. Their volumetric efficiency is 80 per cent. The Army transportation cylinders carry helium at a pressure of 2000 pounds, and those of the Navy, 1800 pounds. The gas, as it comes from these cylinders is the final product used by the Army and Navy in their lighter-than-air craft.

It is necessary for helium to go through a purification process after being used in airships, because there is a small amount of diffusion of the gases in the air through the fabric of the envelope. The gases which do get in are nitrogen, oxygen, and small amounts of carbon dioxide and argon. The most efficient process to purify the helium is that used at the United States Navy plant. This is considerably cheaper and simpler than the separation of the helium from natural gas. The carbon dioxide is removed at a low pressure by treatment with sodium hydroxide solution. Then the gas is compressed to a pressure of 2000 pounds per square inch. Following this compression it is led through interchangers. Then it goes through a series of coils and into a tank. The coils and tank are surrounded by liquid air. This causes the impurities to condense, and they are drained off. Finally the helium is led back through the interchanger to a high pressure storage (1800 pounds). The cost for 98.4 per cent. of the helium purified is less than five dollars per 1000 cubic feet.

Among the more interesting aspects of the various methods for producing helium is the way in which the waste products are utilized. This makes possible a great deal of economy. In the first stage the gases which come from the lower unit of the still are mixed, re-evaporated, and passed back through the forecooler. A certain amount of waste nitrogen is produced in the upper part. This is sent down through the other two parts again and then through the interchanger and forecooler where it cools the incoming gas. All of the waste gases are then mixed and sent to commercial mains for distribution in nearby cities. Practically all of the helium production is in the hands of the U. S. Government. When and if the lighter-than-air craft industry increases in importance, both for military and transportation uses, it will be easily possible for enough helium to be produced economically, provided, of course, that the supply of natural gas holds out.

EDITORIAL

(Continued from page 153)

Each viewpoint shows a different philosophy. Neither can successfully be proved the best because each has a different criterion for judging. Through the ages, the outstanding men have conformed to neither of these two outlooks upon life, but have been a combination of the two where neither grinds with the other. They have the ability to produce and at the same time a sense of what life really is. In view of this fact it follows that anyone who is slaving under technical training is not wasting his time if he has some other fundamental liberal training on which to build. If he can live vigorously, and once in a while forget he is an engineer, then and then only has he any business with a technical education.

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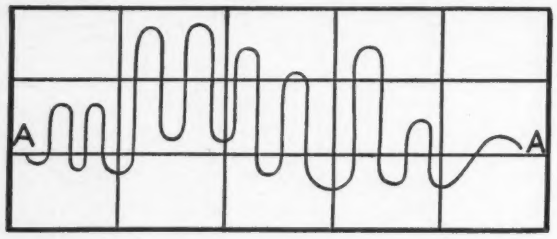

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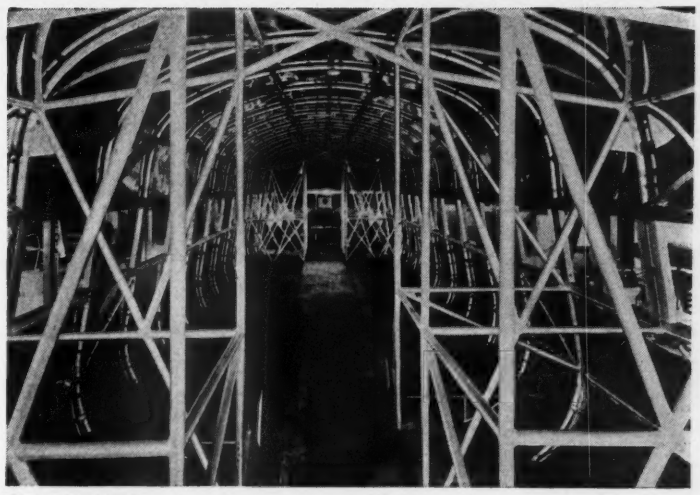


HERE'S HOW—the framework of the light weight, streamlined rail cars for high speed is Lindewelded from chrome-molybdenum steel tubing.

Mastery over all Metals

Welding Makes Jointless Structures Possible in Practically All Commercial Metals and Alloys

By A. B. KINZEL*

One great advantage of using welding is that practically every commercially available metal and alloy can be made by this means into a jointless assembly.

Contributes to Home Comforts

Numerous articles fabricated by welding are found in most homes. Familiar ones cover a wide range of metals—kitchen ware and furniture of aluminum, copper and stainless steel; copper tubing in refrigerators, sheet metal in refrigerator boxes; kitchen cabinets and gas ranges; water pipes of copper, brass, iron and steel; furnaces and hot water tanks of strong heat-resisting irons and steels. Even the tiny alloy wire elements in radio tubes are welded.

Simplifies Automobile Maintenance

Automobile manufacturers use welding for innumerable assemblies where your safety and comfort depend on permanent strength and tightness. The modern automobile repair man also uses welding. With welding he quickly restores broken parts to use again. Steel bumpers, fenders, frames are readily made jointless by welding—as strong as or stronger than the original piece. Cracked cylinder blocks and broken aluminum crank cases are welded. Valves and valve seats are made service free by welding a thin coating of Haynes Stellite to the wearing surfaces to give longer life and added thousands of low cost miles.

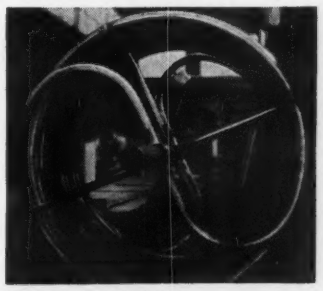
Aids Industrial Users

In industry—for tanks, containers, piping and a wide variety of other machinery and equipment of all sizes, shapes and metals—the use of welding is even more extensive.

Welding Marches Ahead

The wide-spread use of welding for various metals and alloys has been due largely to constant advances in technique and materials. Typical among these is the development of Lindewelding, a procedure for the rapid welding of steel pipe and plate. Speed increases of 50 to 65 per cent and material savings of 25 to 50 per cent over previous methods have been made.

Bronze-welding, welding with a bronze welding rod, is widely used for both repair and production. Smooth joining of metals or alloys of different compositions can be accomplished by bronze-welding. Steel can be bronze-welded to cast iron, bronze and copper can be joined, brass and steel plate can be united.



EVERY METAL—responds to the oxy-acetylene blowpipe. This stainless steel coil for cooling milk has welded joints.

Makes Modern Metal Designs Jointless

Exact procedures for the welding of corrosion-resistant steels and alloys have been developed. Welds so made are sound, strong and ductile. Resistance of the welded joint to corrosion makes it valuable also for use in joining special alloys such as Monel Metal and Everdur. Welded aluminum alloy chairs, tables and other furniture have been made possible through the development of special aluminum welding rods.

At Your Command

Modern welding technique, plus the great variety of metals and alloys on the market today provide many new possibilities for your products. Information and data which will help you use welding to wider advantage may be had from the nearest Sales Office of The Linde Air Products Company, a unit of Union Carbide and Carbon Corporation. These are located at Atlanta—Baltimore, Birmingham, Boston, Buffalo, Butte—Chicago, Cleveland—Dallas, Denver, Detroit—El Paso—Houston—Indianapolis—Kansas City—Los Angeles—Memphis, Milwaukee, Minneapolis—New Orleans, New York—Philadelphia, Phoenix, Pittsburgh, Portland, Ore.—St. Louis, Salt Lake City, San Francisco, Seattle, Spokane and Tulsa.

WELDING ALUMINUM—an architectural plaque, modern in design, is repaired by a modern method.

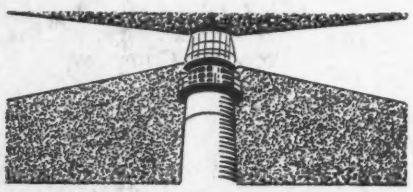
Everything for oxy-acetylene welding and cutting—including Linde Oxygen, Prest-O-Lite Acetylene, Union Carbide and Oxweld Apparatus and Supplies—is available from Linde through producing plants and warehouse stocks in all industrial centers.

*Chief Metallurgist, Union Carbide and Carbon Research Laboratories, Inc., Unit of Union Carbide and Carbon Corporation.

G-E *Campus News*

SEDAN TO SYDNEY

Radio Engineers were up bright and early not long ago to make a two-way radio-conversation test between the General Electric short-wave station W2XAF near Schenectady and station VK2ME at Sydney, Australia, 10,000 miles away. It was 6:30 a.m. in Schenectady and 10 o'clock at night in Sydney. Everything was in readiness, but C. H. Lang, U. of Michigan, '16, manager of the Company's Publicity Dept., who was to talk to officials in Australia, was delayed at his home. On a chance, the radio police test car, which G-E engineers had equipped for two-way radio communication for the Boston Police Dept., was sent to pick up Mr. Lang. From the car, Mr. Lang's voice was sent by ultrashort waves to the G-E plant and from there by land wire to W2XAF for transmission to Australia. Conversation from Australia was picked up at the short-wave station, sent by land wire to the plant, and from there by the special police transmitter to the moving car. So successful were the results, despite the complicated hook-up, that the small sedan continued to cruise about the Schenectady streets for 15 or 20 minutes more, Mr. Lang carrying on his part in the conversation through an ordinary French-type telephone.

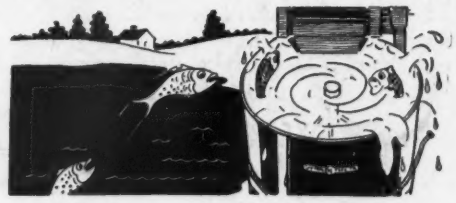


YELLOW LIGHT ON CAPE MAY

The orange-yellow light of General Electric sodium-vapor lamps now illumines roadways in more than 50 installations. It is also being used to light the façades and towers of buildings.

But now this light has another application—in the lighthouse at Cape May, N. J., at the entrance to Delaware Bay. The Cape May Lighthouse was erected in 1859. Its light source is 165 feet above mean high water and can be seen for approximately 19 nautical miles under clear atmospheric conditions. The lens is a first-order, 16-panel, flashing lens rotated by motor drive so that the beam of light has a four-second flash and a 26-second eclipse. The lamp itself does not flash—the rotation of the lens causing the alternate flash and eclipse.

In this test with the sodium-vapor lamp, all equipment has been supplied by the General Electric Company, and the installation was made by the Fourth Lighthouse District.



FISH GYM

The patrons of Joe Medway, a restaurateur up in New York State, literally fished for their dinners. They chose and netted their trout from a large pool. But what made Mr. Medway and his patrons unhappy was that the trout, presumably because of the treacherous refinements of effete pool life, became sissies. They just nosed around listlessly.

One day Mr. Medway gathered up a batch of netting by the pool and placed it in his General Electric washing machine for a rinsing. When he removed the net, there was a trout jumping about the machine in a most sprightly fashion. It exhibited such joyous abandon, in comparison with its sluggish brothers in the pond, that he turned on the activating element again to give it real satisfaction. The trout then accelerated its speed and leaped about in the swirling currents as though it were swimming for life or love in a mountain stream. Mr. Medway threw it back in the pond. It was off like a flash, and had soon churned up the placid waters into a sea of tiny whitecaps with its capers. Then, says Mr. Medway, the bit of spotted dynamite swished in to shore, came to a spray-raising stop, and with wiggles and flops implored its owner for another turn in the washer.

Well, Mr. Medway bought six more General Electric washing machines, and now all the trout are systematically exercised. Mr. Medway is willing to bet that there isn't a single speckled trout from the wildest streams in the country that could last a half a round with his trout. "Because," he says, "they're scientific trained."

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GENERAL ELECTRIC